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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
HSU, JONI	

ART UNIT	PAPER NUMBER
2671	

DATE MAILED: 10/31/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/804,862	XU ET AL.	
	Examiner	Art Unit	
	Joni Hsu	2671	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-30* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-3,19 and 25-29* is/are rejected.

7)☒ Claim(s) *4-18,20-24 and 30* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *3/19/04*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Information Disclosure Statement

1. The information disclosure statement (IDS) submitted on was March 19, 2004 filed after the mailing date of the application on March 19, 2004. The submission is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.

Claim Objections

2. Claim 5 is objected to because of the following informalities: Claim 5 recites "wherein each tile is divided into a plurality subtiles" where it should recite "wherein each tile is divided into a plurality of subtiles". Appropriate correction is required.

3. Claim 11 is objected to because of the following informalities: Claim 11 recites "wherein the depth information for the group of pixel...determine if the group of pixel" where it should recite "wherein the depth information for the group of pixels...determine if the group of pixels". Appropriate correction is required.

4. Claim 17 is objected to because of the following informalities: Claim 17 recites "comprising the step setting a plurality of status flags" where it should recite "comprising the step of setting a plurality of status flags". Appropriate correction is required.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. The factual inquiries set forth in *Graham* v. *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

7. Claims 1-3 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Everitt (US 20040169651A1) in view of Sperber (US006557083B1), further in view of Bilodeau (US006384822B1).

8. With regard to Claim 1, Everitt describes an apparatus for use in a computer graphics system [0002], comprising a depth buffer for storing depth data [0009], wherein the depth buffer is configured to provide depth data for a group of pixels [0010]; a plurality of stencil buffers, the stencil buffers configured to store stencil shadow volume data (*stencil buffers can be used to determine the intersection of objects with the shadow volumes, using a stencil buffer to render*

scenes with shadow volumes is referred to as stenciled shadow volumes, [0021]), wherein at least one of the plurality of stencil buffers is configured to provide stencil shadow volume data for the group of pixels [0010]; and control logic for controlling the plurality of stencil buffers and the depth buffer, wherein the stencil shadow volume data is generated and stored [0009, 0021].

However, Everitt does not teach a plurality of depth buffers, wherein at least one of the plurality of depth buffers is configured to provide depth data for each pixel of the group. However, Sperber describes compressed and uncompressed depth buffers (Col. 5, lines 39-57), wherein the uncompressed depth buffer is configured to provide depth data for each pixel of the group (Col. 10, lines 16-32).

It would have been obvious to one of ordinary skill in this art at the time of invention by applicant to modify the device of Everitt to include a plurality of depth buffers, wherein at least one of the plurality of depth buffers is configured to provide depth data for each pixel of the group as suggested by Sperber because Sperber suggests that this increases the memory bandwidth (Col. 2, lines 13-32). Sperber suggests that uncompressed depth data needs depth data provided for each pixel of the group (Col. 10, lines 16-32).

However, Everitt and Sperber do not teach that at least one other of the plurality of stencil buffers is configured to store stencil shadow volume data for each pixel of the group. However, Bilodeau describes that the stencil buffer is configured to store stencil shadow volume data for each pixel of the group (*stencil buffer on a per-pixel basis, shadow volumes*, Col. 1, lines 52-63).

It would have been obvious to one of ordinary skill in this art at the time of invention by applicant to modify the devices of Everitt and Sperber so as that at least one other of the plurality

of stencil buffers is configured to store stencil shadow volume data for each pixel of the group suggested by Bilodeau because Bilodeau suggests that only pixels having depth values greater than the corresponding depth value stored in the z-buffer pass the z-test (Col. 3, lines 30-33), and the z-testing sets the stencil buffer bits (Col. 3, lines 24-29), and therefore stencil shadow volume data needs to be stored for each pixel of the group.

9. With regard to Claim 2, Everitt describes a first depth buffer, wherein the first depth buffer has a plurality of first depth buffer records, such that each first depth buffer record stores depth data for a group of pixels, where the group of pixels inherently comprises a tile [0010].

However, Everitt does not teach a plurality of depth buffers and a second depth buffer, wherein the second depth buffer has a plurality of second depth buffer records, wherein each second depth buffer record stores depth data for a pixel. However, Sperber describes compressed and uncompressed depth buffers (Col. 5, lines 39-57), wherein the uncompressed depth buffer is configured to provide depth data for each pixel of the group (Col. 10, lines 16-32), as discussed in the rejection for Claim 1.

10. With regard to Claim 3, Everitt describes that the plurality of the stencil buffers comprise a first stencil buffer, wherein the first stencil buffer has a plurality of first stencil buffer records, such that each first stencil buffer record stores the stencil shadow volume data for the tile ([0021], *group of adjacent pixels*, [0010]).

However, Everitt does not teach a second stencil buffer having a plurality of second stencil buffer records, such that each second stencil buffer record stores the stencil shadow

volume data for each pixel, wherein the second stencil buffer record is configured as a partition of the second depth buffer record. However, Bilodeau describes a stencil buffer having a plurality of stencil buffer records, such that each stencil buffer record stores the stencil shadow volume data for each pixel (Col. 1, lines 52-63), wherein the stencil buffer record is configured as a partition of the depth buffer record that stores depth data for a pixel (*z-testing to set the stencil buffer bits, pixels having depth values greater than the corresponding depth value stored in the z-buffer pass the new z-test*, Col. 3, lines 24-33). This would be obvious for the same reasons given in the rejection for Claim 1.

11. With regard to Claim 19, Sperber describes a computer graphics system comprising depth data compression logic configured to generate a compressed depth data (*computer system 300 that implements z-compression*, Col. 4, lines 20-22); data compression logic configured to generate a compressed stencil data (Col. 12, lines 61-62, Table 2); data generation logic configured to generate an uncompressed stencil data (*does not allow compression if the pixels have different stencil values*, Col. 12, lines 62-65, Table 2); and data merging logic configured to selectively merge the compressed stencil data with the uncompressed stencil volume data (Col. 5, lines 39-57).

However, Sperber does not teach shadow data logic configured to generate a stencil shadow data, wherein the stencil shadow data is generated utilizing a stencil shadow volume method. However, Bilodeau describes shadow data logic configured to generate a stencil shadow data, wherein the stencil shadow data is generated utilizing a stencil shadow volume method (Col. 1, lines 55-63).

It would have been obvious to one of ordinary skill in this art at the time of invention by applicant to modify the device of Sperber to include shadow data logic configured to generate a stencil shadow data, wherein the stencil shadow data is generated utilizing a stencil shadow volume method as suggested by Bilodeau because Bilodeau suggests that the stencil buffer can be incremented or decremented, or the pixel can be rejected if the stencil value fails a simple comparison test, and this is useful for effects that involve marking out a region of the frame buffer, and then performing rendering only on the marked region, and this is useful for volumetric effects (Col. 1, lines 55-63).

However, Sperber and Bilodeau do not teach that the depth data corresponds to a group of pixels and the stencil shadow data corresponds to the group of pixels. However, Everitt describes that the depth data corresponds to a group of pixels [0010] and the stencil shadow data corresponds to the group of pixels [0021, 0010].

It would have been obvious to one of ordinary skill in this art at the time of invention by applicant to modify the devices of Sperber and Bilodeau so that the depth data corresponds to a group of pixels and the stencil shadow data corresponds to the group of pixels as suggested by Everitt because Everitt suggests that this reduces the number of stencil buffer updates needed to render shadow volumes, thereby decreasing the pixel fill rate requirements and improving performance. This also has the advantage that any optimization of shadow volume rendering requires little modification of the rendering application [0006].

12. Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Bilodeau (US006384822B1) in view of Sperber (US006557083B1).

Bilodeau describes computer graphics hardware, comprising a means for creating a shadow effect using a stencil buffer (Col. 1, lines 55-63).

However, Bilodeau does not teach using a compressed stencil buffer. However, Sperber describes using a compressed stencil buffer (Col. 12, lines 61-62, Tables 2 and 3).

It would have been obvious to one of ordinary skill in this art at the time of invention by applicant to modify the device of Bilodeau to include using a compressed stencil buffer as suggested by Sperber because Sperber suggests that compression reduces the size of the data block transferred, which saves memory channel bandwidth (Col. 5, lines 33-35).

13. Claims 26-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bilodeau (US006384822B1) and Sperber (US006557083B1) in view of Baldwin (US006798421B2).

14. With regard to Claim 26, Bilodeau and Sperber are relied upon for the teachings as discussed above relative to Claim 25. Bilodeau describes creating shadow mask data in a pixel stencil buffer (Col. 4, lines 41-44).

However, Bilodeau does not teach means for selectively merging shadow mask data for a tile into a pixel stencil buffer, wherein the tile corresponds to a record in the compressed stencil buffer; wherein the tile is comprised of a group of pixels. However, Sperber describes means for selectively merging data for a tile into a pixel stencil buffer, wherein the tile corresponds to a record in the compressed stencil buffer; wherein the tile is comprised of a group of pixels (Col. 9, line 66-Col. 10, line 16).

It would have been obvious to one of ordinary skill in this art at the time of invention by applicant to modify the device of Bilodeau to include means for selectively merging shadow mask data for a tile into a pixel stencil buffer, wherein the tile corresponds to a record in the compressed stencil buffer; wherein the tile is comprised of a group of pixels as suggested by Sperber because Sperber suggests that compressed z-data may be transferred with significantly lower impact on the bandwidth of the memory channel than uncompressed data (Col. 4, lines 58-65).

However, Bilodeau and Sperber do not teach that a subtile is comprised of a subset of the group of pixels. However, Baldwin describes storing tiles in the stencil buffer, wherein the tile is comprised of a group of pixels (Col. 18, lines 43-48; Col. 20, lines 31-35, 43-57); wherein a subtile is comprised of a subset of the group of pixels (Col. 21, lines 57-62).

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to modify the devices of Bilodeau and Sperber so that a subtile is comprised of a subse4t of the group of pixels as suggested by Baldwin because Baldwin suggests that subtiles are needed for more complex operations (Col. 2, lines 7-9, 29-35).

15. With regard to Claim 27, Bilodeau describes means for storing a pixel depth data in a pixel depth data buffer (Col. 3, lines 30-33).

However, Bilodeau does not teach means for storing compressed depth data in a compressed depth data buffer, wherein the compressed depth data corresponds to the tile. However, Sperber describes means for storing a pixel depth data in a pixel depth data buffer; and

means for storing a compressed depth data in a compressed depth data buffer (Col. 5, lines 39-57), wherein the compressed depth data corresponds to the tile (Col. 9, line 66-Col. 10, line 16).

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to modify the device of Bilodeau to include means for storing compressed depth data in a compressed depth data buffer, wherein the compressed depth data corresponds to the tile as suggested by Sperber because Sperber suggests that in some cases, the depth data cannot be compressed, such as data blocks to which locations straddling a primitive boundary are mapped, because compressing these block can generate erroneous results (Col. 5, lines 48-57). The blocks that can be compressed are compressed because compressed z-data may be transferred with significantly lower impact on the bandwidth of the memory channel than uncompressed data (Col. 4, lines 58-65).

16. With regard to Claim 28, Bilodeau describes a means for determining which pixels are in a shadow (Col. 4, lines 55-65).

17. With regard to Claim 29, Bilodeau describes that the means for determining which pixels are in a shadow comprises selectively performing a depth data test on a pixel depth data, wherein the means for determining which pixels are in a shadow further comprises selectively performing a stencil value not equal to zero test on pixel stencil data (Col. 4, lines 55-65).

However, Bilodeau does not teach compressed depth data. However, Sperber describes compressed depth data (Col. 4, lines 54-58), as discussed in the rejection for Claim 26.

Allowable Subject Matter

18. Claims 11-18 would be allowable if rewritten to overcome the claim objections set forth in this Office action.

19. Claims 4-10, 20-24 and 30 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter:

20. The prior art taken singly or in combination do not teach or suggest a first cache configured to communicate data with the depth and stencil buffers for a group of pixels and a second cache configured to communicate data with the per-pixel depth and stencil buffers, as recited in Claim 4. Claims 5-10 depend from Claim 4, and therefore also contain allowable subject matter. The prior art also does not teach that a first portion of the shadow mask data is generated in the compressed stencil buffer and a second portion of the shadow mask data is generated in a pixel stencil buffer, as recited in Claim 11. Claims 12-18 depend from Claim 11, and therefore also contain allowable subject matter. The prior art also does not teach selectively generating the uncompressed stencil shadow data based on the compressed stencil shadow data exceeding a range determined by a format of the compressed stencil shadow data, as recited in Claim 20. Claims 21-24 depend from Claim 20, and therefore also contain allowable subject matter. The prior art also does not teach the computer graphics hardware of Claim 29, further comprising a means for adding specular color to pixels not contained in the shadow.

21. The closest prior art (Snyder US006252608B1) teaches a method for generating a shadow effect in a computer graphics system (*methods and graphics rendering systems for shadowing images*, Col. 4, lines 30-31), comprising the steps of rendering an object with diffuse color (Col. 30, lines 57-64); generating pixel depth information for a scene for storage in a pixel depth buffer; generating depth information for pixels (*pixel buffer serves as the depth buffer for storing the two closest z values*, Col. 86, lines 21-23), testing the depth information in the depth buffer to determine if the group of pixels may utilize a shadow mask data in a stencil buffer; generating the shadow mask data; generating a shadow area, wherein the shadow area is determined by the shadow mask data contained in the pixel stencil buffer; and adding specular color to objects not in the shadow area (Col. 86, lines 21-24; Col. 4, lines 40-63; Col. 19, lines 35-39; Col. 30, lines 57-64). However, Snyder does not teach that a first portion of the shadow mask data is generated in the compressed stencil buffer and a second portion of the shadow mask data is generated in a pixel stencil buffer.

Prior Art of Record

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Snyder (US006252608B1) teaches improved methods and graphics rendering systems for shadowing images (Col. 4, lines 30-31).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Joni Hsu whose telephone number is 571-272-7785. The examiner can normally be reached on M-F 8am-5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ulka Chauhan can be reached on 571-272-7782. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

JH

Kee M. Tung
Primary Examiner